The Struggle for Air Superiority

The Air War over the Middle East (1967–1982) as a Case Study

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Russia's announcement in October 2018 regarding the transfer of advanced S-300 surface-to-air missiles (SAM) to Syria following Israel's numerous aerial attacks, once again brought to the fore the struggle between aerial forces and the weapons systems tasked with preventing the free operation of aerial forces in the Middle East. This struggle began almost immediately with the utilization of aerial forces in World War I (WWI), and the struggle to gain aerial freedom of action or air superiority can be identified in all the wars since then. The definition of *air superiority* includes the main role of the aerial force, which is to gain freedom of action in the air and to prevent the enemy from achieving the same, at both the strategic and tactical levels. This freedom of action is vital for the ability to support operations on land and at sea in the areas of close air support (CAS) and air interdiction (AI) as well as for bombing in the enemy's strategic depth.[1]

The goal of this article is to examine the aerial campaigns between Israel and the Arab states (with an emphasis on Egypt and Syria). A discussion of the operational history of the Israeli Air Force (IAF) between the years 1967 and 1982 will be used to analyze an additional chapter in the historical struggle to gain air superiority, while also highlighting the importance of gaining air superiority and maintaining it over armies that rely on a ground-based air defense (GBAD) to prevent it. A further goal is to examine the formation and implementation of the various strategies applied by the belligerents in their confrontations and the system of learning lessons and applying them from one campaign to another. For example, beginning in 1969, the air war in the Middle East turned into a lethal encounter between American and Soviet technologies and served as an important operational laboratory for both superpowers.[2] This trend continues today, and therefore an analysis of the history of the air wars in the Middle East can provide insights and lessons for those that are currently operating against advanced and dense GBAD systems.

The first part of this article will briefly examine the concept of *air superiority* and the historical struggle to achieve it. The second, main part of the article, will analyze the confrontation between Israel and the Arab states through four case studies: the Six-Day War (1967), the War of Attrition (1969–1970), the Yom Kippur War (1973), and the First Lebanon War (1982). In these wars, which were indeed brief and conducted in a limited geographical area in global and historical

terms, the aerial forces on all sides had an important—and at times—crucial role. Also, through these case studies it is possible to learn not only about how the belligerents coped but also about their learning curves and how they applied the lessons they learned from one confrontation to another. Thus, the article will contribute, if only modestly, to the research of the dynamic between offensive weapons systems and defense systems.

Air Superiority

Air superiority can be defined as a military situation in which the aerial force of a country has freedom of operation that is restricted in time and space but that is sufficient for the aerial force to complete its missions without significant interference on the part of the enemy.[3] The other side of air superiority is the ability to prevent the enemy from using the air space, thereby preventing him from efficiently operating his aerial force, while at the same time, the side that has gained air superiority can complete its aerial missions. This is why John Warden—whose book *The Air Campaign* (1988) can be considered one of the most important in the field of operating aerial forces—argues that gaining air superiority is a fundamental condition for completing the mission and even for achieving victory in war. Warden also wrote that since World War II (WWII), not one main attack succeeded against an enemy that enjoyed air superiority, and not one defense managed to hold up against an enemy that ruled the air.[4] Furthermore, one must strive to gain air superiority in a relatively short time and with a low rate of attrition of the aerial force. In this way, freedom of action is made possible in the tactical, operational, and strategic space, according to the relevant requirements of each campaign or war. Since this is the case, it is critical to gain the ability to operate the aerial force freely and effectively in strategic missions as well as tactical ones—and primarily in support of the land battle.[5]

From a historical point of view, the struggle over air superiority began almost as soon as armies had aircraft of various types, with airplanes being the primary weapons systems for aerial combat. Indeed, antiaircraft artillery (AAA) was developed during WWI, but it was used mainly to defend land targets and was limited in its ability to be a dominant element in the struggle for air superiority. This trend continued into WWII. Thus, for example, one of Germany's most important opening moves in its invasion of the Soviet Union was a comprehensive, surprise attack on Soviet airfields. The damage inflicted upon the Soviet air force while it was still on the ground provided Germany with air superiority over the operational zone in which its armored corps were moving. Britain and the United States gained air superiority over the battlefields of Western Europe in a complex operation that combined aerial combat with the targeting of factories that pro-

duced airplanes and airplane parts and the infrastructure for refining oil into airplane fuel. Thus, air superiority was achieved in a lengthy process for both offensive purposes (the strategic bombing campaign) and defensive purposes, meaning defense of the advancing land forces.[6]

In the 1950s, new weapons entered operational service that created a new threat to the freedom of action of aerial forces and their ability to gain air superiority. In this period, armies began to equip themselves with SAMs and radar-guided AAA. In fact, a multilayered air defense system was developed that, with the backing of interceptor aircraft, created a significant change in the ways in which an attacking aerial power could realize the principle of achieving air superiority. Nonetheless, since the enemy aircraft continued to be a threat, the struggle over air superiority simply became more complicated and continued to include air-to-air combat.

Besides the need for interceptors, it also became clear that new weapons must be integrated and that a system must be constructed to provide relevant intelligence regarding the location of enemy antiaircraft (AA) systems. These trends brought about a series of transformations in the construction of aerial forces, especially among air forces—such as Israel and the United States—that had sanctified the offensive dimension of gaining air superiority through aircraft. These air forces were compelled to adjust to the changing aerial battlefield and equip themselves with new technologies and weapons, change their attack tactics, and adapt their organizational structure to the new challenge posed by the enemy's aerial defense systems. Therefore, the challenge of achieving air superiority became more difficult and created a need to construct a new operational mix consisting of several components, as opposed to relying solely on fighter aircraft. This process of adaptation involved numerous technological and operational difficulties, which led to failures and heavy losses to the attacking forces—until the air forces reacquired the ability to triumph in the struggle for air superiority. These trends were clearly manifested in the Israeli–Arab wars between 1967 and 1982.

The IAF in 1966–1967

Until its victory in the Six-Day War, Israel lacked strategic depth and natural borders as well as the ability to engage in a lengthy war of attrition. This operational reality brought Israel to concentrate on building an offensive force that could decide the issue quickly, while focusing on quality manpower and weapons.[7] In this reality, the IAF was an important and central component of the military power of the State of Israel. The main reason for this was the fact that the IAF was an offensive force that could act quickly, as its main force (pilots and ground crews) was on regular active duty, contrary to the ground forces, which relied mainly on reserves. Therefore, the mission of the IAF was to prevent the Arab air

forces from conducting aerial attacks on the Israeli rear and disrupting the mobilization of the reserves.[8] The increase in the quantity and quality of the aerial offensive capabilities of the Arab states, and particularly of Egypt in the years prior to 1967, further heightened this threat.[9] In the second half of the 1950s, Egypt began to build airbases in the Sinai Peninsula, which significantly shortened the primary flight distances to Israel's main urban centers. Furthermore, the fact that Israel lacked strategic depth prior to 1967 prevented it from intercepting enemy aircraft beyond its own borders. This problem worsened as Egypt was equipped with a wide range of Soviet-made airplanes, some of which were the most advanced models in the Soviet arsenal, such as the MiG-21 and the Tu-16 Badger strategic bombers, which Egypt received in 1960 and were capable of carrying 10-ton bombs to Israel's urban and industrial heartland.[10]
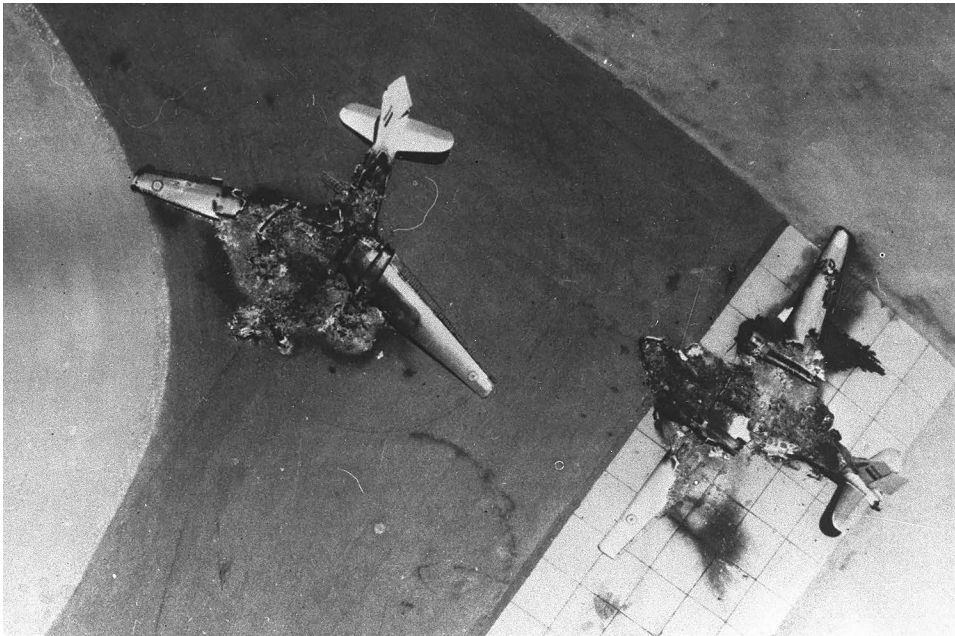
(Photo courtesy of Government Press Office [Israel])

Figure 1. Destroyed on the ground. The Israeli Air Force destroyed enemy aircraft on the ground during the opening stages of the Six-Day War.

These developments brought Israel to develop a doctrine that singled out the achievement of air superiority as the most important role of the IAF, which was tasked with finding ways to fulfill this objective.[11] Accordingly, the IAF adopted an offensive approach that determined that the enemy air forces must be destroyed in the beginning of the war and their air bases struck at the same time. In the Egyptian context, this largely meant the immediate destruction of the Tu-16

bombers before they took off for Israel. Only after this goal was fulfilled could the IAF engage in CAS and AI missions.[12] Facing the threat from the Tu-16 bombers and in light of the deterioration that began in the middle of May 1967, the IAF planners decided to focus on a preventive strike on the Egyptian Air Force. Subsequently, in the morning of 5 June 1967, the IAF initiated Operation Focus (Moked).[13] According to the myth surrounding this operation, the Egyptian Air Force was destroyed in three hours.[14] The truth is a bit more complex, but at the end of the first day of combat, Israel did enjoy almost complete air superiority over the Egyptian theater of war and afterward also vis à vis Syria and Jordan.[15]

Israel's maneuvering forces were afforded effective CAS, which greatly facilitated the swift breakthrough of the Egyptian lines of defense in the Sinai by Israeli armored divisions, which operated almost entirely absent an aerial threat.[16] Once again it was proven that ground maneuvers required aerial support and that such support can be effective only if air superiority had been gained. In addition, Israel's air superiority made a crucial contribution to the CAS and AI operations that aided the swift ground maneuvers in the other fronts, especially in the difficult terrain of Judea and Samaria and the Golan Heights.[17] Lon Nordeen argues that if the Arab air forces had not been destroyed and Israeli air superiority achieved in the beginning of the war, more air-to-air fights would have been conducted. In other words, fewer aircraft would have been available for CAS missions, and he opines that as a consequence the duration of the war would have been extended, as the ground forces would not have benefited from effective CAS, which would also have increased their losses.[18]

The War of Attrition (July 1969–August 1970)

The Israeli victory in the Six-Day War was decisive—too decisive. Three Arab armies were defeated in a span of six days, and the State of Israel tripled its territory. The Arab rout severely damaged the national and pan-Arab prestige of Egypt's leader, Gamal Abdel Nasser, who strengthened his relationship with the Soviet Union in return for rehabilitating his army. Egypt also began a process of learning the lessons of the war, with the understanding that its army was inferior with respect to maneuver battles against the Israeli armor and in light of the obvious superiority of Israel in the air.[19] Consequently, Egypt sought ways to neutralize the Israeli advantages. The Arab armies, and especially Egypt's, began to construct additional air bases to disperse their airplanes. Concrete shelters were constructed for the airplanes to prevent them from being hit while on the ground, hardened fuel depots and command posts were also built, and air bases and other strategic facilities were afforded denser GBAD systems.[20] These trends took away from Israel the possibility of a future aerial bombing as had occurred on 5 June

1967. However, the most critical change was the shift from an air defense system based on fighter aircraft to a GBAD system. This approach was realized and manifested in the War of Attrition.

Confronted with the Soviet Union's rearming of the Arab states, the United States expanded its military aid to Israel and began supplying two types of fighter aircraft: first, the A-4 Skyhawk, and then the F-4E Phantom II, both of which were more advanced, relative to the existing IAF arsenal. These airplanes significantly upgraded the operational capabilities of the IAF, which despite the victory in 1967 found itself in a weak position, both in light of the rearming of the Arab air forces and also due to the IAF inventory of aircraft, which was old and clearly unfit for another war. In fact, only the Mirage airplanes could take part in the forthcoming air superiority campaign, but the IAF only had 60 Mirages that were airworthy and operational. The arrival of the new American planes caused a second technological revolution in the IAF.[21] In addition to the airplanes, Israel also received from the United States a variety of advanced weapons and munition systems, turning the upcoming confrontation between Israel and Egypt, i.e., the War of Attrition, into a proxy war between Soviet and American technology and weapons systems.

The Egyptian president realized that he could not embark on an all-out war against Israel, but to gain political achievements, military action was necessary. Therefore, Egypt adopted a strategy of attrition, with the aim of increasing the involvement of the superpowers, similar to what occurred in 1956, in the hope that they would pressure Israel into retreating from the territory it had captured in 1967 without reaping any political benefits. Another goal of the strategy of attrition was to inflict damage on the Israeli economy, as it would be burdened with financing an extended war but even more so with the understanding that Israel would be unable to sustain a large number of casualties over an extended period.[22] On 3 March 1969, President Nasser declared an end to the ceasefire along the Suez Canal front, and Egyptian artillery began massive bombardments of the makeshift Israel Defense Forces (IDF) positions in the eastern sector of the canal.[23] The IDF ground forces did not have an adequate answer for the Egyptian bombardments, and the losses grew daily. In the same period, the IAF was busy with reorganizing the new weapons that had arrived from the United States, and the commander of the IAF, Maj Gen Mordechi Hod, preferred preparing the Israeli Air Force for an all-out war over intervening in a limited confrontation that would wear down the force, both materially and in manpower.[24] Nevertheless, at the end of July 1969, the IAF too began taking an active part in the War of Attrition.

The participation of the air force began first with achieving freedom of action over the Suez Canal. The initial operations focused on destroying the SAM bat-

teries that protected the Egyptian artillery and seizing the initiative against the Egyptian Air Force, to attrite the latter's force in air-to-air combat. This meant aggressively seeking out MiG airplanes to down them, and for this purpose Israeli airplanes flew demonstratively in airways leading to important Egyptian air bases and waited for Egypt to scramble interceptors toward them. The flight areas were devoid of GBAD systems, and therefore, only interceptors could set forth to protect the Egyptian sites. For these missions, pilots with vast air-to-air combat experience were selected, and they received permission beforehand to intercept Egyptian airplanes, meaning that they did not require permission from air control. Thus, the moment enemy planes were sighted, the pilots could engage with them. The IAF also operated a decoy system in which transport aircraft and helicopters were flown, and when the MiG planes were launched toward them, the Israeli interceptors, which were flying below the Egyptian radar, climbed up. The IAF also operated electronic countermeasure (ECM) systems that jammed the Egyptian radar systems and the communication channels between the airplanes and the ground-control intercept. The Israeli pilots called these battles "the Texas and Arizona battles," over the course of which dozens of MiG airplanes were downed as opposed to only two Israeli Mirages, whose pilots managed to bail safely in Israeli territory.

Israel's aerial activities in July 1969 destroyed the SAM batteries on the western bank of the Suez Canal and caused Egypt to withdraw its MiG airplanes westward. The IAF achieved air superiority over the canal, which enabled starting the methodical bombardment of Egyptian ground targets (Operation Boxer), particularly the artillery batteries. These bombing operations were highly successful, and the number of Israeli casualties dropped significantly. Toward the end of 1969, the Israeli government approved a series of bombings deep in Egypt's territory. Called Operation Blossom, these attacks were the first baptism by fire of the Phantom aircraft that had arrived in Israel in September 1969.[25] The IAF's in-depth bombing campaign caused a serious crisis in Egypt, which had lost its air superiority over crucial areas, especially in light of the fact that Israeli aircraft were flying freely over the capital, Cairo. In fact, the IAF was capable of bombing any target it wanted to in Egypt at any time, without having to face any response from Egypt, which was unable to prevent them.[26] On the other hand, the attempts by the Egyptian Air Force to conduct in-depth bombings of Israel failed. Nonetheless, despite the military success of the in-depth bombings, Israel's political goals were not achieved, which were, unofficially, to force Nasser to resign. The IAF operations made Nasser feel a real sense of threat and that Egypt had no operational option against the IAF. In the beginning of January 1970, Nasser flew to Moscow to request immedi-

ate assistance and even asked that Soviet air defense forces deploy in Egypt and assume responsibility for defending the Egyptian skies.[27]

Within several months, the Soviet Union deployed a comprehensive air defense system that included the new SA-3 batteries and an upgrade to the SA-2 system.[28] In addition, 72 MiG-21 and three MiG-25 aircraft were sent to Egypt for patrol missions over the Sinai Peninsula, and several early warning radar systems also arrived in Egypt. In fact, the Soviet Union transferred to Egypt an entire air defense division, manned by 15,000 Soviet officers and soldiers. The division was deployed according to Soviet doctrine, which was to create a protective envelope around Cairo and then counter the Israeli air superiority by extending the air defense toward the canal. In the end, the Soviet presence in Egypt brought the in-depth sorties of Operation Blossom to a halt, due to the increased threat posed by the SAM systems and the fear that Soviet forces would be harmed in the bombings. Therefore, in April 1970, the IAF returned to concentrating on preserving its air superiority over the Suez Canal and 30 km west of it. However, despite the repeated attacks on the SAM batteries, the Soviet forces managed to advance eastward toward the canal. Thus, we may argue that it is possible that the aerial warfare until April 1970 brought Nasser to the verge of a ceasefire, but the Soviet intervention, which limited Israel's aerial activities, prevented a clear Israeli victory.

Israel did not yet have an effective ECM response to the Soviet air defense system and, therefore, turned to the United States, which had some experience with such systems in Vietnam. However, the United States also did not yet have in its possession decisive operational answers to suppressing the air defense systems of North Vietnam. Nonetheless, the United States shared with Israel the experience it had gained in Southeast Asia, which included sending technical advisors and advanced electronic systems as well as delivery of Shrike antiradiation missiles, which at the time were still of limited effectiveness.[29] The truth was that the IAF emerged from the War of Attrition without a clear operational response, neither technological nor doctrinal, to the Egyptian air defense system, particularly in light of the SA-6 mobile SAMs with which the Soviets were now equipping Egypt.[30]

One of the most important factors that spurred Egypt to strengthen its GBAD capabilities and to rely on a dense air defense system that included missiles and artillery was the aerial battles conducted during the War of Attrition.[31] From Israel's point of view, these battles were part of the struggle for air superiority, while from the Egyptian side, the goal was to restore confidence to the Egyptian pilots and also to try and prevent the IAF from flying freely over Egypt. However, during these battles, Egypt lost 111 airplanes in air-to-air combat, as opposed to four airplanes lost by Israel (a kill ratio of 1:27.75). This demonstrated once again that

the operational quality of Egyptian pilots was, generally speaking, lower than that of their Israeli counterparts, even though some of these pilots had gained the trust of the Soviet Union.[32] The aerial campaign reached its peak on 30 July 1970 in an aerial encounter between MiG-21 airplanes manned by Soviet pilots and IAF Mirage airplanes.

Due to the expansion of the Soviet involvement in Egypt, Soviet pilots began to plan aerial combat with the IAF to create direct contact with Israeli airplanes and down them.[33] In response, the IAF decided to plan an aerial battle in which the Soviet pilots would be induced to chase after IAF airplanes that would penetrate Egyptian territory. This operation, dubbed Operation Pomegranate 20 (Rimon 20), was planned as an ambush in which Israeli airplanes were armed and prepared for aerial battle but simulated an air-to-ground attack and a reconnaissance flight so as to seem defenseless and incapable of conducting air-to-air combat. The Soviet pilots swallowed the bait, and in the ensuing battle, five MiG-21 airplanes were downed and one Mirage was hit, though its pilot succeeded in making it back to Israel.[34] This was the first aerial battle that the Soviet Union conducted since WWII, and it ended with a rout. For political reasons, Israel and the Soviet Union tacitly agreed to discontinue the clash, but in the long term, this Israeli victory was to its detriment.

On 3 August 1970, the IAF conducted Operation Hair 265 against the SA-3 batteries, during which a missile ambush downed a Phantom airplane and hit another that managed to get back to Israeli territory. The results of the operation made it clear to the IAF that it did not have a tactical solution for the Egyptian GBAD system and that it severely curtailed Israel's air superiority. Accordingly, Israel's primary demand in the negotiations for an agreement to end the war was that Egypt would commit to refrain from advancing missiles to the Suez Canal. The ceasefire agreement was indeed signed on 7 August, but Egypt violated the agreement the very same day, advanced missiles to the canal, and later began to construct a dense air defense system on the western bank of the canal. The United States, which recognized the Egyptian violations, pressured Israel to hold its fire, and in return sent it a large amount of military aid, including advanced weapons and ECM systems that were supposed to help the IAF if Egypt renewed the hostilities.

It can be determined that in the aerial campaign of the War of Attrition, Israel was the victor. Generally, the IAF achieved and preserved air superiority, and the Egyptian Air Force had almost no operations deep in Israel's territory.[35] However, it is impossible to know what would have happened if the war had extended beyond August 1970, in light of the increasing density of the Egyptian air defenses and the fact that they were being operated by the Soviets. An initial clue as to the lethality of this new arrangement was provided in the beginning of August 1970,

and as mentioned, when the war concluded Israel still did not have an effective operational response to the Egyptian air defense systems.

From the Egyptian point of view, the operational lesson to be learned was clear, as was the modus operandi in a possible future confrontation. Although the IAF enjoyed a distinct superiority in air-to-air combat, the War of Attrition proved the difficulty of operating in an environment saturated with various AA systems. But there was more: Egypt was compelled to recognize Israel's superiority in air-to-air combat and, in the subsequent three years, constructed one of the densest integrated air defense systems (IADS) in the world.[36] To the SA-2 and SA-3 missiles were added new weapons systems such as the SA-6, which was mobile and did not require constructing revetments prior to the deployment of the batteries, as well as the shoulder-fired SA-7 and the advanced ZSU-23x4 AA cannon. In this manner, Egypt gained air superiority within a range of about 15 miles east of the Suez Canal, in territory that was actually under Israeli control. The Syrian Army learned the same lesson, as the Syrian Air Force also suffered from inferior performance in air-to-air combat with Israel. Consequently, Syria also constructed a massive and dense GBAD system.[37]

The surface-based AA system constructed by the Arab armies was composed of a variety of weapons; the fields of fire of the fixed SAM batteries overlapped each other, and this fixed system was reinforced with mobile batteries that could change positions quickly, surprise the Israeli aerial attackers, and close gaps if the fixed systems were damaged. The armored forces and infantry were equipped with the shoulder-fired SA-7, and the maneuvering forces were also accompanied by mobile AA batteries, primarily the ZSU-23X4.[38] With this integrated system, it was possible to hit airplanes flying at various heights, and it was these dense and sophisticated defense systems that the IAF faced when it went to war in October 1973.

The Yom Kippur War

The Yom Kippur War (6–24 October 1973) was primarily a land war within which the air campaign was clearly integrated. However, the dense air defense systems of the Egyptian and Syrian armies dramatically curtailed the ability of the IAF to participate in land combat and provide effective CAS to the Israeli armored forces, which were critically outnumbered, especially in the Golan Heights front.[39] The literature on this war has adopted a similar point of view, according to which Israel was surprised by the combined attack on both fronts and that this surprise was the cause of the large number of casualties suffered by the IDF, especially in the first days of the war. However, when examining the IAF, the picture is more complex. The IAF command began intensive preparations for war 10 days prior to its breakout, the main reason being a large aerial battle that

took place with the Syrian Air Force on 13 September 1973. In this battle, 12 MiG-21 airplanes were downed versus one Mirage plane lost by Israel, which feared that Syria would embark on a large-scale reprisal operation (though the estimate by Military Intelligence of a low probability for war was not yet altered).

As part of the preparations, IAF reserves were called up, the combat readiness of the combat squadrons was raised, and operational plans were updated, especially the plans for achieving air superiority immediately with the outbreak of war. These plans included a combined and simultaneous strike on the air bases of the Arab states along with the destruction of the air defense systems, after which the IAF would be free to assist the ground forces. In other words, the operational plan of the IAF on the eve of the war was similar to Operation Focus six years prior. Twenty-four hours before the beginning of the war, the commander of the IAF, Maj Gen Beni Peled, ordered his deputies to prepare the aircraft for an attack on the Syrian SAM system. However, the political echelon rejected Peled's request to conduct a preventive strike on the Arab air bases, fearing that Israel would be presented as the instigator of the war and would thus lose the support of the United States.[40]

At 1350 hours, a massive artillery bombardment began in the Golan Heights and the Sinai, and 10 minutes later, three Syrian divisions crossed the Golan border and the Egyptian Army began crossing the Suez Canal. At the same time, the aerial forces of both countries embarked on attack sorties against targets in the Golan Heights and the Sinai, while helicopters attempted to land commandos in the Israeli rear. At this stage, the IAF planes were in the midst of changing munitions, but many Egyptian and Syrian airplanes were downed in air-to-air combat, and in general, the damage done was not severe. The IAF had to cancel its original plans and dedicated itself to defending the Israeli air space near the front lines, attacking the invading forces and providing CAS to the ground forces of the IDF, which found themselves outnumbered. In effect, due to the reality in the war fronts and especially in the Golan Heights, the IAF was forced to change its operational priorities from achieving air superiority to immediate support of the ground forces.[41] It is this change that caused the large number of losses of Israeli airplanes in the first days of the war. The numbers speak for themselves. During the war, the IAF lost 102 airplanes, of them only five in air-to-air combat, while downing 277 airplanes from the air forces of all the Arab states that participated in the war or sent expeditionary forces (a kill ratio of 1:55.4).[42]

Most of the Israeli airplanes were downed by the ZSU-23x4 cannons, due to the fact that to evade the missiles, the Israeli pilots had to fly at lower altitudes, which were controlled by the AAA fire. The bare statistics indicate that the Arab armies fired hundreds of missiles to down one Israeli plane. After the war, the IAF

estimated that 36 Israeli airplanes were downed by missiles (SA-2, SA-3, SA-6, and SA-7), though it is impossible to say which missile was responsible for the kill, as the air defense launched missile barrages of all types. Nonetheless, the IAF estimated that 1,800 SA-2, SA-3, and SA-6 missiles were launched along with 12,000 SA-7 missiles. In other words, for every airplane downed by the Egyptian and Syrian air defenses, they launched 383 SAMs.[43] Although these are just numbers, the IAF materiel and personnel was depleted, and it lost one-quarter of its operational force during the war.

Another major problem the IAF suffered from in the first days of the war, until 10 October, was the swift change in the missions the IAF pilots were conducting, without sufficient preparation or up-to-date and relevant intelligence. Once again, these changes were a result of the swift breakthrough of the Arab forces, whereby on 7 October, it seemed that the Golan Heights were going to fall due to the swift advance of Syrian forces in the southern Golan and the fact that in this area nearly the entire Israeli armored force had been destroyed.[44] Israeli Minister of Defense Moshe Dayan ordered the IAF to dedicate most of its force to CAS and AI missions in the southern Golan. At that time, the IAF was in the midst of Operation Quarrel (Tagar), which was meant to destroy Egypt's air defense system as the first stage toward attacking the bridgeheads that the Egyptian Army had built on the Suez Canal.[45] The attacks, which were conducted in the morning of 7 October, did not achieve their goals, and the airplanes were being armed for additional sorties, when the decision was made in the middle of the day to divert the IAF to the southern Golan. To gain freedom of action over this arena, the Israeli aircraft embarked on Operation Model (Doogman) to destroy the Syrian air defense system along the border. However, the pilots were sent on their missions without up-to-date intelligence. The SA-3 batteries had changed their positions, and Syria also had mobile SA-6 launchers, the location of which was also unknown in real time. Thus, Operation Model also failed, though the Israeli aircraft were downed not by SAMs but by AAA fire. However, the failure was a consequence of other factors as well. The first was the absence of an airborne electronic warfare (EW) system tasked with jamming and deceiving the detection capabilities of the Syrian air defense system.[46] Also, there was a mishap in the operation of the drones as decoys by the 200 Squadron. Thus, although the Syrians did launch SAMs against these decoys, the attacking aircraft failed to arrive right behind them. When the aerial attack on the Syrian defenses finally began, 200 Squadron had no drones left to fly as decoys.[47]

Although the threat of the missiles remained in force until the end of the war, it gradually lessened as the war went on, as the IAF managed to gain air superiority and even preserve it. There were several reasons for this. First, Syria's supply of

SA-6 missiles was running out. This enabled the IAF aircraft to operate at higher altitudes beyond the range of the AAA, as the Israeli pilots were able to deal very successfully with the older missiles.[48] A second reason was the Soviet failure to replenish the supply of missiles in Syria due to the bombing of Syrian air bases and the strikes on Syrian convoys that were making their way to the front. A third reason was the steep learning curve of the IAF pilots, who devised new attack tactics as the fighting was going on and integrated technological improvisations developed during the war and immediately installed on the airplanes.[49] A fourth reason was that after the IDF forces crossed the Suez Canal (16 October), the tanks on the western bank began to fire directly on the missile and artillery batteries. This opened up for the Israeli aircraft a corridor that was free of threats, enabling them to fly in relative freedom and to provide CAS to the ground forces on the western bank of the Suez Canal.

As mentioned, the IAF lost a fourth of its operational force, and many pilots were killed or captured. However, despite these losses and the inability to gain freedom of action over the Golan Heights and the Suez Canal in the first days of the war, the IAF embarked on a series of CAS and AI missions. Alongside the struggle for tactical air superiority, the IAF also conducted in-depth bombings, especially in Syria. Furthermore, both Syria and Egypt appreciated the power of the IAF to the extent that they did not send their aircraft to attack in the depth of Israel; instead, they launched several surface-to-surface FROG (free rocket over ground) missiles toward Israeli targets, and in the beginning of the war Egypt also launched two Kelt air-to-surface missiles (ASM), which were intercepted by Mirage planes. Thus, we can state that Israel preserved complete air superiority at the strategic level and that the Arab aerial forces failed to strike Israel's strategic centers of power or to disrupt its movements (logistic or combat) toward the fronts.

From the military point of view, Israel won the Yom Kippur War. However, this victory did not immediately translate into a political achievement, and it came with a heavy death toll, which turned the war into a national trauma. Thus, following the historical paradigm in which the losing army or the army that failed in the war initiates processes of rehabilitation and organizational and operational reform, the IDF, including the IAF, began learning the lessons of the war. As far as the IAF was concerned, Operation Model was a microcosm of the systemic failure of the IAF. On the other hand, in Syria, the functioning of the air defense system in this campaign was considered an operational success, which could be made even more effective by making it denser and adding operational components.

The operational failure had a negative effect on the morale of the IAF, and it demonstrated the great difficulty involved in coping with a dense air defense system. Nonetheless, the failure spurred the IAF to find operational solutions to this

problem. The solution consisted of a mix of standoff weapons, EW means, and precise battlefield intelligence. Consequently, many resources were invested in intelligence, specifically in constructing a ground-based observation system that would transmit to the attacking aircraft the location of the mobile missile batteries in real time.[50] This system was supported by a drone system that was upgraded to conduct intelligence, surveillance, and reconnaissance (ISR) missions and light up targets. As we shall see below, this operational mix was employed with unprecedented success against the Syrian IADS in the First Lebanon War.

The IAF in 1974–1982

Two trends characterized the actions taken by the IDF after the Yom Kippur War. The first was a process of studying the war and learning its lessons, which influenced, among other things, the IDF's procurement plan.[51] Preparations for the possible renewal of hostilities were also continued, especially vis à vis the Syrian Army. Furthermore, despite the diplomatic rapprochement between the United States and Egypt and the beginning of peace talks between Israel and Egypt, the IDF continued to prepare for the renewal of hostilities on the southern front as well. At the same time, and as a second trend, the daily confrontation with the Palestinian organizations, which had strengthened their grasp in southern Lebanon after they were forced to leave Jordan, continued. In the context of this dual strategy, the IAF had a central role, as its operational systems were integrated in the general preparations for an additional regular war as well as in the exhausting combat against the terror organizations in Lebanon.[52]

The IAF learned a number of lessons in the Yom Kippur War, the main one being that the absolute superiority it enjoyed in aerial combat did not suffice for achieving air superiority in an arena that had a dense air defense.[53] The IAF acted in several directions to enable it to cope more effectively with this system and its operational challenges. In fact, the IAF concentrated its efforts on formulating a doctrine that would bring about the suppression of the enemy air defense (SEAD). The first aspect of this was the acquisition of attack helicopters that could provide CAS and also hold attacking armored columns.[54] The purpose of this acquisition was to divert the highest possible amount of airplanes to SEAD missions and to attain a significant concentration of force when attacking the air defense systems of the Arab armies. The second aspect was the development of an offensive doctrine for the destruction of IADS, and the third was developing improved ISR capabilities that would provide accurate, real-time intelligence regarding the location of the mobile batteries. This was a direct lesson learned from Operation Model, as mentioned above, which failed primarily due to the fact that the Israeli planes could not locate the mobile SA-6 batteries.

In the years following the Yom Kippur War, the IAF began to receive F-15 tactical fighter aircraft and later also the F-16 multirole fighter aircraft. These aircraft began to operate against the Syrian Air Force, which attempted to intercept the airplanes that were bombing terrorist targets in south Lebanon. These dogfights ended with the IAF achieving complete air superiority in the skies of south Lebanon. The Syrian response to this was the construction of a dense SAM system in Lebanon's Beqaa region.[55] In summer 1981, the IAF planned to strike this system, but the operation was cancelled due to American pressure. By summer 1982, the Syrian SAM system was further reinforced, with the number of batteries reaching 19, including mobile SA-6 batteries supported by the ZSU-23x4 AAA cannons for thwarting low-altitude attacks. In this year Israeli Tadiran Mastiff and IAI Scout drones played a crucial role, routinely monitoring the Syrian IADS. Israel also used drones as decoys that attracted AAA fire, and it is possible that some of them were intercepted. The payoff was that the missile batteries revealed their location and also the frequencies and electronic signature of the Syrian radar systems, which helped develop ECM for jamming the Syrian radar. All the information that was gathered became part of the IAF's attack plan, with forces awaiting the order to execute it. This occurred in the beginning of June 1982 (Operation Mole Cricket 19). Throughout three consecutive days (9–11 June), the IAF destroyed the Syrian missile system in Lebanon's Beqaa and downed over 80 Syrian airplanes that were launched to defend the batteries.[56]

After the Yom Kippur War, Syria continued to base its IADS on Soviet principles, so that the doctrine and technology of the Soviet Union took a hard hit. The operation demonstrated that a simultaneous attack, from the air and the ground, is the solution for suppressing and destroying a dense air defense system. Israel applied a combination of air and ground weapons systems, along with EW, intelligence measures, and means of deception to cause the SAM batteries to reveal themselves to munitions that home in on radar radiation. In this operational mix, the unmanned aerial vehicle (UAV) system played an important role in the gathering of precise visual intelligence (VISINT) regarding the location of the missile batteries and the radar vans and in exposing the characteristics of the radiation emitted by the radar systems.[57] This information arrived in real time, which enabled locating and jamming the radar systems during the attack using EW means or destroying them with standard AGM-70 antiradiation missiles (ARM) fired by the Phantom airplanes.[58] The IAF also used drones as decoys. The radar profile of the drones simulated that of fighter planes, and as planned, the Syrian missile batteries located the drones and fired missiles toward them. This act exposed the precise location of the batteries in real time as well as the radar radiation, and consequently various types of ARM were launched at them. At the

same time, airborne and ground-based electronic means located the batteries and exposed them to ground fire that was combined with aerial attacks by the F-4 planes. After the radar systems were taken out, the missile batteries themselves were bombed from the air and the ground, using general-purpose bombs and cluster bombs to target the teams manning the batteries as well.[59] The drones provided the ground-based and aerial fire systems with real-time updates on the damage inflicted, and batteries that were not damaged at all or insufficiently so were attacked for a second time. Thus, the batteries were attacked sequentially rather than concurrently, to ascertain their destruction and dedicate resources to a repeat attack if necessary, or move on to the next target if not.

During the attack upon the missile batteries, an operational paradox occurred. Half an hour after the Israeli attack began, Syria understood that its missile system was being fatally hit. To protect it, Syria scrambled airplanes to intercept the attacking Israeli aircraft. One must recall that Syria increasingly relied on a GBAD, which was a consequence of its understanding that its air force was inferior to the air-to-air combat capabilities of the IAF pilots. UAVs flying over the Syrian air bases in Syria itself provided VISINT on the takeoff of the Syrian airplanes. This information was immediately relayed to the IAF's ground-based and aerial (Northrop Grumman E-2 Hawkeye) control units, assisting the controllers in vectoring the IAF aircraft to intercept the Syrian MiGs. The F-4 planes stopped their attacks and made way for the F-15 and F-16 aircraft that were accompanying them. Twenty-three Syrian planes were downed without the IAF incurring even one loss.[60]

At the end of the first day, the Syrians advanced additional missile batteries, including for the first time the cutting-edge SA-8.[61] On 10 and 11 June, the IAF once again conducted attack sorties in which the batteries that were not destroyed in the first day were demolished and to hit the new batteries that had arrived in Lebanon's Beqaa Valley. The Syrian Air Force continued to scramble its airplanes to intercept the attacking aircraft, but once again, the MiGs were downed by the accompanying Israeli aircraft. In all, 30 SAM batteries were destroyed, and in the aerial battles, 85 Syrian airplanes were downed, versus not one Israeli interceptor. The kill ration was, therefore, 0:85.[62] It is impossible to say which specific component had a decisive effect. The attack plan created an operational synergy composed of aerial and ground-based weapons. As a result of the operation, the IAF achieved air supremacy over Lebanon, and this dominance affected the ensuing ground operations and the high combat effectiveness of the CAS missions.[63]

Conclusion

This article analyzed the struggle and the learning competition between Israel and the Arab countries in the field of aerial warfare. While Israel continued to rely

on interceptor aircraft, Egypt and Syria increasingly relied on GBAD to prevent Israeli superiority. The clearest manifestation of these trends was the Yom Kippur War, in which the IAF experienced great difficulties in executing CAS and AI missions, and the maneuvering Arab armies enjoyed operational freedom of action in the first days. Thus, we may argue that preventing Israeli superiority in fact created a type of air superiority for the Arab countries. On this background, we may present three main conclusions. The first is that this strengthens the argument regarding the critical importance of gaining air superiority, so that the aerial force is able to fulfill its CAS and AI missions, i.e., supporting the maneuvering ground forces. The second is the fact that air defense systems are highly complex and multidimensional and that a complex system must be employed to counter it. The third conclusion is the critical need for a process of studying and learning lessons after a confrontation and with the prospect of employing aerial forces in an environment that has a dense and complex GBAD system.

From the air war perspective, the Six-Day War followed a pattern similar to WWII. The destruction of most of the aircraft of the Arab air forces while on the ground granted almost compete air superiority to Israel and contributed decisively to the success of the land maneuvers during the war. After 1967, the Egyptian and Syrian armies constructed air defense systems that were indeed very dense but relied only on a surface component and lacked aerial support. Since the IAF failed to find an effective operational system for suppressing Egypt's air defense system, we can argue that at the end of the War of Attrition and in the initial days of the Yom Kippur War, the IAF had by and large lost its ability to achieve air superiority over the war fronts. Nonetheless, the Yom Kippur War proved that interceptor aircraft remained a crucial component of this system, as once the operational conditions tilted in favor of the IAF, it managed to gain control of the air, though not completely, and assist the ground forces to a greater extent. This point was driven home dramatically in 1982, when the IDF enjoyed air superiority over the battle fields in Lebanon, after mortally wounding the Syrian air defense in Lebanon. That said, it is worth remembering that Palestine Liberation Organization forces lacked an aerial force, and its AAA defense was no challenge for the IDF. In fact, from 1982 to the present, the IAF has enjoyed air superiority, evidenced by the hundreds of bombing sorties conducted on targets in Syria in the past few years, in the course of which only one Israeli airplane was downed by a SAM.

In a relatively short span of 15 years, four confrontations took place between Israel and the regular armies of Arab states. The struggle for air superiority in the Arab–Israeli wars demonstrates very well the process of learning lessons by the military and their application from war to war. Thus, the aerial war in the Arab–Israeli conflict can serve as a historical model for examining the force-building

processes in the area of airpower, and especially how these processes came to be manifested operationally.

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Notes

1. William W. Momyer, *Airpower in Three Wars (WWII, Korea, Vietnam)* (Maxwell AFB, AL: Air University Press, 2003), 125.

2. *See* Robert F. Futrell, *Ideas, Concepts, Doctrine: Basic Thinking in the United States Air Force (vol. 2), 1961-1984* (Maxwell AFB, AL: Air University Press, 1989), 484–85. Throughout the years, Israel transferred to the United States a great deal of information regarding the Soviet technologies that fell into its hands, such as the MiG-21 that an Iraqi deserter pilot flew to Israel in 1966 (Operation Diamond), SA-2 missiles that the IDF captured in 1967, and particularly the Soviet P-12 (NATO reporting name Spoon Rest), which served as the search radar for the SA-2 missiles. Toward the end of the 1960s, the United States began supplying Israel with aircraft and advanced technologies, and after the Yom Kippur War the IAF was equipped with the new F-15 Eagle fighter aircraft.

3. Giulio Douhet, *The Command of the Air* translated by Dino Ferrari, (Washington DC: Office of Air Force History, 1983), 24; and Woodford A. Heflin, ed., *The USAF Dictionary* (Maxwell AFB, AL: Air University Press, 1956), 37.

4. John A. Warden, *The Air Campaign: Planning for Combat* (Washington, DC: National Defense University Press, 1988), 13.

5. P. D. L. Gover, "Air Supremacy – The Enduring Principle," in *War in the Third Dimension: Essays in Contemporary Air Power*, ed. R. A. Mason (London: Brassey, 1986), 61.

6. See the discussion in Walter J. Boyne, *The Influence of Air Power upon History* (Gretna: Pelican, 2003), 251–80.

7. Brereton Greenhous, "The Israeli Experience," in *Case Studies in the Achievement of Air Superiority*, ed. Benjamin F. Cooling (Washington DC: Center of Air Force History, 1994), 565–66; and David Rodman, *Sword and Shield of Zion: The Israeli Air Force in the Arab-Israeli Conflict, 1948–2012* (Brighton: Sussex Academic Press, 2013), 1–4, 15–16.

8. Itai Brum, "Israeli Air Power," in *Global Air Power*, ed. John A. Olson (Washington, DC: Potomac Books, 2011), 144.

9. Regarding the Egyptian Air Force prior to 1967, *see* Edgar O'Ballance, *The Third Arab-Israeli War* (London: Faber & Faber, 1972), 56–60; and Lon O. Nordeen and David Nicolle, *Phoenix over the Nile: A History of the Egyptian Air Power 1932–1994* (Washington, DC: Smithsonian Institute Press, 1996), 193–96.

10. Greenhous, "The Israeli Experience," 576.

11. Nonetheless, the IAF was also tasked with the traditional missions of aerial forces, such as AI and CAS, strategic depth bombing, and various logistical missions.

12. Regarding the IAF before the Six-Day War, see: O'Ballance, *The Third Arab-Israeli War*, 49–55.

13. See the discussion in Sterling Michael Pavelec, *War and Warfare since 1945* (New York: Routledge, 2017), 63.

14. In this regard see the comprehensive article by Kenneth M. Pollack, "Air Power in the Six-Day War," *Journal of Strategic Studies* 28, no. 3 (2005): 417–503. *See also* Shmuel L. Gordon, "Air Superiority in the Israel–Arab Wars, 1967–1982," in *A History of Air Warfare*, ed. John A. Olson (Washington, DC: Potomac Books, 2010), 133–34. Gordon points out the fact that throughout the entire war the struggle for air superiority continued, though with a clear advantage to the IAF.

15. The aerial campaign of the Six-Day War has been heavily researched, with Operation Focus being emphasized, naturally. See, for example, Lon Nordeen, *Fighters over Israel* (New York: Orion Books, 1990), 66–87. For an Egyptian point of view of the Israeli aerial attack, *see* Nordeen and Nicolle, *Phoenix over the Nile*, 202–18; and Kenneth M. Pollack, *Arabs at War: Military Effectiveness, 1948–1991* (Lincoln: Nebraska University Press, 2002), 62–63, 74–75.

16. Regarding CAS in the Six-Day War, *see* Greenhous, "The Israeli Experience," 503–09.

17. Greenhous, 509.

18. Nordeen, *Air Warfare in the Missile Age*, 123. *See also* Rodman, *Sword and Shield of Zion*, 29–31.

19. Peter Allen, *The Yom Kippur War* (New York: Charles Scriber's Sons, 1982), 31.

20. Nordeen and Nicolle, *Phoenix over the Nile*, 227–28. *See also* Traver N. Dupuy, *Elusive Victory: The Arab-Israeli Wars, 1947–1974* (New York: Harper & Row, 1978), 547–49

21. The first revolution was the arrival of the French jet airplanes in the 1950s.

22. Pollack, *Arabs at War*, 90–91.

23. For a comprehensive review of the IAF in the War of Attrition, *see* Rodman, *Sword and Shield of Zion*, 42–45.

24. Dupuy, *Elusive Victory*, 549.

25. Operation Blossom was a series of in-depth bombings conducted between January–April 1970. In this period, 118 sorties were made, primarily by the Phantom aircraft, against radar stations, SAM batteries, and army bases in Egypt's depth and even around Cairo.

26. Nordeen and Nicolle, *Phoenix over the Nile*, 246–47.

27. David A. Korn, *Stalemate: The War of Attrition and Great Power Diplomacy in the Middle East, 1964–1970* (Boulder, CO: Westview, 1992), 198; and Nordeen and Nicolle, *Phoenix over the Nile*, 248–49.

28. The SA-3 was a medium-altitude missile intended to complete the coverage of the (high-altitude) SA-2 system and the (low-altitude) AAA. Israel's attempts to secure intelligence on the system by capturing a radar station and transferring it to Israel failed (Operation Robinson and Sheshet, 21 May 1970).

29. See the discussion in Edgar O'Balance, *The Electronic War in the Middle East 1968–1970* (London: Faber and Faber, 1974), 102–12.

30. Meir Finkel, *On Flexibility: Recovery from Technological and Doctrinal Surprise on the Battlefield* (Stanford, CA: Stanford University Press, 2011), 166.

31. Nordeen and Nicolle, *Phoenix over the Nile*, 250–51. The authors cite an American intelligence report according to which between July 1967 and August 1970, Egypt lost 109 airplanes as opposed to only two that Israel lost. Ibid, 255.

32. Pollack, *Arabs at War*, 96.

33. Mark A. O'Neill, "Air Combat in the Periphery: The Soviet Air Force in Action during the Cold War, 1945-89," in *Russian Aviation and Air Power in the Twentieth Century*, eds. Robin Higham, John T. Greenwood, and Von Hardesty (London: Frank Cass, 1998), 227–28.

34. Nordeen, *Fighters over Israel*, 111–12; and O'Neill, "Air Combat in the Periphery," 228.

35. On 11 October 1969, sixteen Egyptian airplanes attacked targets in the Sinai. Eight of them were downed by Mirage airplanes and another three by Hawk missiles. After this, Egypt stopped attacking targets in the Sinai. *See* Pollack, *Arabs at War*, 95.

36. Kenneth P. Werrell, *Archie to SAM: A Short Operational History of Ground-Based Air Defense* (Maxwell AFB, AL: Air University Press, 2005), 148–49.

37. On the lessons of the War of Attrition as leading to the construction of a dense air-defense system, *see* Nordeen and Nicolle, *Phoenix over the Nile*, 257–61.

38. For a discussion of the air defense systems of the Egyptian and Syrian armies, *see* Werrell, *Archie to SAM*, 149–53.

39. In the beginning of the war there were 200 Israeli tanks facing 1,500 Syrian tanks of various types, including the new Soviet T-62 model.

40. George W. Gawrych, *The Albatross of Decisive Victory* (Westport, CT: Greenwood Press, 2000), 169–70.

41. Regarding the IAF in the first hours of the war, *see* Dupuy, *Elusive Victory*, 550–51.

42. Nordeen and Nicolle, *Phoenix over the Nile*, 303–05.

43. Greenhous, "The Israeli Experience," 597–98; and Pollack, *Arabs at War*, 123–25, 498–501.

44. Regarding the combat in the Golan Heights, *see* Dupuy, *Elusive Victory*, 445–61. The actions of the IAF in the Golan Heights in the first two critical days of the war are described in Nordeen, *Fighters over Israel*, 124–25.

45. Nordeen and Nicolle, *Phoenix over the Nile*, 280–82.

46. The airborne EW system was at the Sinai front at the time, preparing for Operation Quarrel, and was unable to get to the Golan Heights front in time.

47. Shmuel Gordon, a Phantom pilot in the Yom Kippur War who went on to have a career in academia, determined that the failure of operations Model and Quarrel was not a consequence of the effectiveness of the Arab air defense system or a lack of ECM measures in the IAF but of the decision to attack quickly without real-time intelligence. *See* Gordon, "Air Superiority in the Israel-Arab Wars, 1967–1982," 146; and Gordon, "The Air Force and the Yom Kippur War: New Lessons," *Israel Affairs* 6, no. 1 (1999): 221–36.

48. The Syrians had fired all their missiles by the third day of the war. As a result, during the IDF counterattack in the Golan Heights (11 October), the IAF benefited from a relatively high level of freedom of action, which enabled it to provide more effective CAS.

49. *See* Finkel, *On Flexibility*, 171–76

50. Foreign sources claim that this is the primary mission of the Kingfisher unit ("Shaldag," Unit 5101)—to use lasers to light up targets for fighter-bombers that then destroy the targets with different types of precision guided munitions (PGM). *See* Rodman, *Sword and Shield of Zion*, 60–61; and David Guttenfelder, "Israeli Commando Missions Come Out of the Shadows," *USA Today*, 13 August 2006, http://usatoday30.usatoday.com/news/world/2006-08-13-commando-missions_x.htm.

51. Anthony H. Cordesman and Abraham R. Wagner, *The Lessons of Modern War*, (vol. 1): *The Arab–Israeli Conflicts, 1973–1989* (Boulder, CO: Westview Press, 1990), 110–14. In 1976, Israel purchased the F-15 airplanes, and in 1980 the first F-16 airplanes arrived in Israel.

52. Rodman, *Sword and Shield of Zion*, 54–55.

53. Nordeen, *Fighters over Israel*, 179–80.

54. At this time the United States was also thinking about how to stop the masses of Soviet armor in case of an attack in Central Europe. This thinking resulted in the development of the AirLand Battle doctrine, which included the integration of new weapons, one of the most prominent being the new AH-64 Apache attack helicopter. The US Air Force was also equipped with a tougher aircraft for CAS missions, the A-10 Thunderbolt. Although attack helicopters are also exposed to ground fire, perhaps to a greater extent than airplanes, they are able to locate to safe places and launch their munitions from beyond the range of antiaircraft fire. The IAF purchased the AH-1 Cobra and the MD-500 Defender from the United States, which arrived in Israel in 1975 and 1979, respectively.

55. Trevor N. Dupuy and Paul Martell, *Flawed Victory: The Arab–Israeli Conflict and the 1982 War in Lebanon* (Fairfax, VA: Hero Books, 1986), 90.

56. Cordesman and Wagner, *The Lessons of Modern War*, 110–19; and Pollack, *Arabs at War*, 532–34.

57. VISINT provides an up-to-date overhead picture of the areas of action. This mechanism enables locating the target and swiftly closing fire circuits, as the ISR means mark the target, and the relevant fire elements in the sector execute a precise attack on it. Afterward, VISINT enables estimating the success of the attack and attacking once again, if necessary.

58. Israel also developed a version of the missile that was fired from trucks.

59. Benjamin S. Lambeth, *Moscow's Lessons from the 1982 Lebanon Air War* (Santa Monica, CA: RAND, 1984), 5–8.

60. Nordeen, *Fighters over Israel*, 170–76.

61. This is a tactical, short-range mobile SAM system aimed at low-flying aircraft.

62. Two Israeli airplanes were downed by ground fire.

63. Dupuy and Martell, *Flawed Victory*, 119–22; Greenhous, "The Israeli Experience," 599–600; and Cordesman and Wagner, *The Lessons of Modern War*, 203.

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